

ATS-09590

N73-27383

Final Report
to
National Aeronautics and Space Administration

INFRARED SITE TESTING ON MT. LEMMON
AND CATALINA OBSERVATORY

by
Gerard P. Kuiper

Lunar and Planetary Laboratory
University of Arizona, Tucson, Arizona

NASA Grant NGR-03-002-270

27 July 1973

Final Report for Infrared Site Sources

Two of the first Westphal sky noise meters were installed in the Catalina Mountains 18 March 1971. One unit was installed adjacent to the 28-inch telescope at Site II of the Catalina Observing station, approximately 8,450 feet above sea level. The second unit was installed at the summit of Mt. Lemmon, approximately 9,160 feet above sea level. During the initial period many problems were encountered in keeping the equipment running. If needed, we can supply records pertaining to the maintenance of these instruments. These records will show, for example, that a number of modifications and changes were required before relatively satisfactory operation was achieved.

The instrument adjacent to the 28-inch telescope was operated during the spring of 1971 for the purpose of obtaining a direct comparison between the sky noise measurements from Westphal's apparatus and actual sky noise as routinely observed at the 28-inch telescope as part of a sky mapping project at 10 microns. Both the 28-inch system and the Westphal system were operated simultaneously whenever conditions permitted.

Mr. Westphal and Dr. Low compared the results from several daytime and nighttime runs. It was found that when photometric conditions prevailed a positive correlation existed between the output of the two instruments. In particular, the strong diurnal effect, in which the sky noise increases abruptly at sunrise and falls markedly after sunset, was reproduced by both instruments. There was one exceptional period in which the daytime sky noise was only slightly greater than the nighttime level. This experiment

appears to show that, at least under certain conditions, there is a strong correspondence between the quantity measured by the Westphal instrument and true sky noise as encountered during an astronomical observation. However, it should be noted that sky noise is an extremely complex and poorly understood collection of atmospheric and instrumental effects. Caution should be used in making generalizations. In particular, sky noise results with one instrument may differ greatly from those obtained under identical atmospheric conditions. The dependence of sky noise on beam size and aperture size has not yet been determined, nor has the power spectrum been studied with any detail. Spatial effects are often confused with temporal effects. Thus, it is fair to conclude on the basis of what we now know that the interpretation of the results obtained by the Westphal survey is a very difficult undertaking.

The instrument on Mt. Lemmon was operated as part of the site testing program. It should be understood that no great effort was made to operate the instrument when the quality of the sky was problematical. On many occasions fractional nights were not obtained because of rapidly changing sky conditions. There were also occasions on which logistics problems prevented operation of the instrument even when sky conditions were acceptable.

In his preliminary report of last year Jim Westphal gave results from July 1971 to June 1972 for the instrument located on the summit of Mt. Lemmon. During July and August the equipment was all in Pasadena undergoing modification. We agreed there was little point of trying to operate during our summer rainy season. Our records are vague on just

when the equipment was reinstalled by Westphal in Sept. 1971, however, we experienced difficulties in obtaining satisfactory operations and on 10 October 1971 we notified Westphal. He suggested we return the equipment to Pasadena. Our records show that 26 October 1971 was the next day of operation. It is significant that in Westphal's preliminary report Mt. Lemmon was charged with no good sky in September and October. Our observing records show several excellent nights in September and October. When informed of this discrepancy Jim Westphal admitted that this was unfair. We have not received a final report from Westphal and do not know what adjustment, if any, was made. Clearly, this error alone is sufficient to make any conclusion based on these results highly questionable.

In addition to the problem of September and October our observing records show the following results: On eleven nights we have data from the 61-inch telescope near the summit of Mt. Lemmon and results from Westphal's report. Comparison shows that (1) on 5 nights there is good agreement, i.e., the nights were photometric and "sky noise" was low (2) on three nights "sky noise" was indicated low by Westphal but our records show clouds and no observations (3) on the remaining three nights Westphal reported bad sky noise while our records show excellent 10 and 20 micron photometry all night! We do not understand these discrepancies, they may be caused by faulty equipment or by error in processing the data. In any case we feel that the relatively small differences found between sites may not be above the confidence level of the survey. Surely a study should be made of the survey to determine its confidence level at each site.

Finally, it should be noted that the period during which the Mt.

Lemmon sky noise data were obtained was on the whole an excellent year.

This is shown by comparing our observing logs for that year with previous years dating back to 1964. For example, the winter of 1972-73 was radically different from the previous winter. Had the survey been conducted a year later or a year earlier, totally different results would have been obtained. For all these reasons we feel that only very careful use should be made of the results produced by this program.